

## LUNG CANCER RISK ASSOCIATED WITH CIGAR AND PIPE SMOKING

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A case-control study of 1,529 histologically confirmed male lung cancer cases and 2,899 controls matched for sex, age, hospital of admission and interviewer was conducted in France between 1976 and 1980. The results presented concern the effects of smoking habits, especially cigar and pipe use, on the occurrence of lung cancer, in a total of 38 exclusive cigar smokers, 61 exclusive pipe smokers and 586 mixed tobacco smokers. Exclusive cigar or pipe use (RR = 5.6 and 1.6 respectively) has been shown less harmful than exclusive cigarette smoking (RR = 13.3), mixed cigar and cigarette smoking (RR = 8.5) and mixed pipe and cigarette smoking (RR = 8.0). Different inhalation practices were observed according to smoking habits: while among exclusive cigarette smokers 29.8% never inhaled the smoke, among exclusive cigar and exclusive pipe users these percentages were 89.5% and 86.9% respectively. No significant increase with greater exposure to cigar was found among mixed cigar and cigarette smokers after adjustment for exposure to cigarettes, defined by duration and daily consumption of cigarettes (RR = 1.20), and by type of cigarettes smoked—light or dark, filter or nonfilter (RR = 1.13). Similar results were observed among mixed pipe and cigarette smokers after adjustment for cigarette exposure (RR = 0.95 and 1.04).

Smoking of pipe or cigar tobacco appears to entail a far lower risk of lung cancer than cigarette smoking (Peto and Doll, 1984). Lung cancer mortality rates for pipe and cigar smokers are about one-quarter of those seen for cigarette smokers in the UK studies, and one-eighth of those in the US studies (Bailey, 1984).

The association between lung cancer and non-cigarette tobacco use has been reviewed in two reports (US Surgeon General, 1979, 1982); several epidemiologic studies have shown higher risks among lifetime cigar or pipe smokers when compared to non-smokers, but lower risks when compared to lifetime cigarette smokers; also, lung cancer risk increased with the amount of cigars or pipes smoked. Some studies have shown that the risk for cigar or pipe smokers, who are also cigarette smokers, appeared to be intermediate between the high risk for exclusive cigarette smokers and the low risk for exclusive cigar or pipe smokers. These results have recently been confirmed (Joly *et al.*, 1983; Lubin *et al.*, 1984b).

We now report the results on cigar and pipe use from a case-control study undertaken to evaluate the role of the different types of tobacco on lung cancer.

### MATERIAL AND METHODS

An epidemiologic study on lung cancer was conducted simultaneously in 5 European countries with the support of the US National Cancer Institute. In France, a total of 1,625 cases with histologically confirmed lung cancer and 3,091 controls matched for sex, age at diagnosis ( $\pm 5$  years), hospital of admission and interviewer were included in the study between 1976 and 1980.

The characteristics of this study have been described in previous reports on French data (Benhamou *et al.*, 1985), and on the international data as a whole (Lubin *et al.*, 1984a). The results reported here concern all French males interviewed in the study, i.e. 1,529 cases and 2,899 controls.

The distribution of histological types of lung cancer according to smoking habits is presented in Table I. Of the 1,529 cases, 1,092 were of squamous type (71.4%), 169 were undifferentiated (11.0%), 133 were adenocarcinomas (8.7%), 4 were of mixed Kreyberg I and Kreyberg II types (0.3%) and 131 were unspecified type (8.6%).

The principal diagnoses among the 2,899 controls were: bone diseases (13.4%), trauma (12.3%), benign tumors (11.2%), viral and other infectious diseases (10.5%), malignant tumors (8.2%), neurological diseases (7.2%) and digestive diseases (3.7%).

The risks associated with exposure to cigarettes, cigars (or cigarillos), pipes or possible associations of these 3 types of tobacco will be detailed. Smokers are defined as people having smoked at least one cigarette, or one cigar or one pipe per day for at least one year. Data recorded about cigarette smokers have been previously described (Benhamou *et al.*, 1985). The following data on cigar and pipe use were collected for each smoker: age at beginning and duration of smoking, frequency and depth of inhalation. In addition, the length of the cigar usually smoked, the two last brands of cigars smoked, and for each the number of cigars per day, was recorded. Similarly, the number of pipes smoked per day was recorded. The daily consumption of cigars has been calculated by dividing the total lifelong number of cigars smoked by the overall duration of smoking in days.

Adjusted RR of lung cancer and 95% CI have been estimated with the Mantel-Haenszel method (Mantel, 1963).

### RESULTS

The distribution of the different patterns of tobacco use among males is presented in Table II. Eighty-five percent of the cases and 61% of the controls were lifetime smokers; in contrast, few men were lifetime cigar or pipe smokers: 0.6% and 0.3% respectively among cases, and 1.0% and 1.9% respectively among

Abbreviations: CI, confidence interval; RR, relative risk(s).

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TABLE I - PERCENTAGE DISTRIBUTION OF HISTOLOGICAL TYPES AMONG MALES WITH LUNG CANCER ACCORDING TO SMOKING HABITS

Histological types	Non-smokers	Cigar only	Pipe only	Cigarette only	Cigar and cigarette	Pipe and cigarette	Other types	Total
Total	36	9	5	1298	68	76	37	1529
Squamous	55.6	77.8	100.0	71.8	67.7	80.3	56.8	71.4
Small, oat, spindle	5.6	11.1	—	8.3	14.7	6.6	8.1	8.4
Kreyberg I type not distinguished	5.6	—	—	2.6	2.9	1.3	2.7	2.6
Adenocarcinoma	25.0	—	—	8.5	8.8	2.6	16.2	8.7
Mixed Kreyberg I and II	—	—	—	0.3	—	—	—	0.3
Kreyberg type unspecified	8.3	11.1	—	8.5	5.9	9.2	16.2	8.6

TABLE II - RELATIVE RISKS OF LUNG CANCER ACCORDING TO DIFFERENT SMOKING PATTERNS

Type of tobacco	Number of cases	Number of controls	RR <sup>1</sup> (95% CI)	p
Non-smokers	36	650	1.0	
Cigars only	9	29	5.6 (2.3-13.5)	<0.001
Pipes only	5	56	1.6 (0.5-4.5)	NS <sup>2</sup>
Cigarettes only	1298	1759	13.3 (9.3-19.1)	<0.001
Cigarettes and cigars	68	144	8.5 (5.4-13.6)	<0.001
Cigarettes and pipes	76	172	8.0 (5.1-12.6)	<0.001
Cigars and pipes	1	19	1.0 (0.1-7.0)	NS <sup>2</sup>
Cigarettes, cigars and pipes	36	70	9.3 (5.3-16.2)	<0.001
Total	1529	2899		

<sup>1</sup>All RR were calculated versus non-smokers. <sup>2</sup>NS: not significant.

controls. When compared to non-smokers, an excess of lung cancer risk ( $p < 0.001$ ) was found for: lifetime cigarette smokers (RR = 13.32), mixed cigar and cigarette smokers (RR = 8.53), mixed pipe and cigarette smokers (RR = 7.98) and mixed cigarette, cigar and pipe smokers (RR = 9.29). An increased risk ( $p < 0.001$ ) was also found for lifetime cigar smokers (RR = 5.60). In contrast, RR for lifelong pipe smokers (RR = 1.61), although increased, was not statistically significant. This lack of significance may be due to the small number of cases in this smoking category.

Lung cancer risk with years of cigar use was estimated after adjustment for cigarette exposure, defined by duration of cigarette smoking and by number of cigarettes smoked per day. The risk was not significantly increased with greater duration of cigar smoking (RR = 1.20), after adjustment for cigarette exposure (Table III). The same analysis was performed after adjustment for type of cigarette smoked (light or

dark) and use of filter. Three categories were defined: the first one concerned those having smoked filter cigarettes for at least half of their tobacco-smoking history, whatever the type of tobacco smoked; the second concerned those having smoked filter cigarettes and also light tobacco for less than half their smoking history; and the last concerned those having never smoked anything but dark tobacco non-filter cigarettes. The lung cancer risk was not significantly increased with greater duration of cigar smoking (RR = 1.13), after adjustment for type of cigarettes smoked (Table IV). The adjusted RR were recalculated with number of cigars smoked per day instead of duration of cigar smoking and similar results were obtained.

The same analyses were performed among mixed pipe and cigarette smokers (Tables V and VI). RR of lung cancer was not significantly increased with greater pipe exposure after adjustment for duration of cigarette smoking and number of cigarettes smoked per day (RR

TABLE III - RR<sup>1</sup> OF LUNG CANCER BY YEARS OF CIGAR USE AND BY DURATION AND NUMBER OF CIGARETTES SMOKED (CASES/CONTROLS)

Cigar use (yr)	Duration of cigarette smoking and number of cigarettes/day					Adjusted RR <sup>a</sup> on cigarette smoking characteristics (95% CI)
	0 yr	<35 yr		≥35 yr		
	0 cig.	<20 cig.	≥20 cig.	<20 cig.	≥20 cig.	
< 15	1.00 (1/9)	0.56 (1/16)	6.95 (17/22)	2.00 (4/18)	6.35 (12/17)	1.00
≥ 15	3.60 (8/20)	1.69 (3/16)	2.81 (5/16)	3.13 (8/23)	9.56 (17/16)	1.20 (0.67–2.17)

<sup>1</sup>All RR were calculated versus only cigar smokers for less than 15 yr. <sup>2</sup>Chi-square test of homogeneity was not significant.

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#### Inhalation

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TABLE IV - RR<sup>1</sup> OF LUNG CANCER BY YEARS OF CIGAR USE AND BY TYPE OF CIGARETTES SMOKED (CASES/CONTROLS)

Cigar use (yr)	Type of cigarettes smoked				Adjusted RR <sup>2</sup> for cigarette smoking characteristics (95% CI)
	0 cig	Mostly filter	Mostly non-filter, mostly dark	No filter, all dark	
< 15	1.00 (1/9)	1.20 (2/15)	8.18 (10/11)	4.21 (22/47)	1.00
≥ 15	3.60 (8/20)	1.50 (3/18)	4.20 (7/15)	5.21 (22/38)	1.13 (0.64-1.99)

<sup>1</sup>All RR were calculated versus only cigar smokers for less than 15 yr. <sup>2</sup>Chi-square test of homogeneity was not significant.

TABLE V - RR<sup>1</sup> OF LUNG CANCER BY YEARS OF PIPE USE AND BY DURATION AND NUMBER OF CIGARETTES SMOKED (CASES/CONTROLS)

Pipe use (yr)	Duration of cigarette smoking and number of cigarettes/day					Adjusted RR <sup>2</sup> on cigarette smoking characteristics (95% CI)
	0 yr 0 cig.	<35 yr		≥35 yr		
		<20 cig.	≥20 cig.	<20 cig.	≥20 cig.	
≤10	1.00 (0/5)	1.35 (3/28)	5.10 (9/20)	4.45 (9/23)	13.64 (15/12)	1.00
>10	1.17 (5/51)	3.86 (6/18)	3.82 (8/24)	3.67 (9/28)	9.87 (17/19)	0.95 (0.56-1.62)

<sup>1</sup>All RR were calculated versus any pipe smokers for 10 yr or less. <sup>2</sup>Chi-square test of homogeneity was not significant.

= 0.95) or for type of cigarettes smoked (RR = 1.04). In Tables III and V, age at first cigarette was verified to be similar in each smoking category for mixed smokers. At the same time, in Tables IV and VI, duration and daily consumption of cigarettes were verified to be similar.

A separate analysis was performed among mixed cigar and cigarette smokers who first smoked cigarettes and then changed to cigars. It appears that their lung cancer risk was significantly lower (RR = 0.40,  $p < 0.01$ ) than that of lifetime cigarette smokers after adjustment for the whole duration of smoking (*i.e.*, cigarettes plus cigars). The significant decrease in risk was likely to be due to the differences in inhalation characteristics: about 15% of the patients who switched from cigarettes to cigars inhaled cigarette smoke but never inhaled cigar smoke. A similar study was conducted for mixed pipe and cigarette smokers versus lifetime cigarette smokers; the adjusted risk was not significantly lower (RR = 0.34), probably because of the small number of patients.

#### Inhalation

The RR associated with inhalation of cigar, pipe and cigarette smoke according to smoking history, are presented in Table VII. The percentage of cases and controls who never inhaled the cigar smoke was greater among lifetime cigar smokers (67% and 97% respectively) than among mixed cigar and cigarette smokers

(50% and 68% respectively). RR of lung cancer were significantly increased ( $p < 0.05$  linear trend tests) with the frequency of inhalation of cigar smoke for exclusive cigar smokers as well as for mixed cigar and cigarette smokers.

For mixed smokers, the risk remained significantly higher (RR = 2.71  $p < 0.06$ ) when adjusted for inhalation of cigarette smoke. Similarly, among lifetime pipe smokers more cases and controls never inhaled the pipe smoke (100% and 86% respectively) than among mixed pipe and cigarette smokers (59% and 73% respectively). A significant increase in lung cancer risk ( $p < 0.05$ ) was found with the frequency of inhalation of pipe smoke among mixed pipe and cigarette smokers; however, this increase in risk disappeared when inhalation of cigarette smoke was taken into account (RR = 1.11). The percentage of cases and controls who never inhaled cigarette smoke was greater in both cigar and cigarette smokers (44% and 57% respectively), and in both pipe and cigarette smokers (29% and 51% respectively) than in lifetime cigarette smokers (24% and 34% respectively). In each smoking category (cigar and cigarette, pipe and cigarette, and exclusive cigarette), an increasing lung cancer risk ( $p < 0.10$ ) was found with greater exposure to cigarette smoke. Moreover, half of the mixed cigar and cigarette smokers never inhaled cigar and cigarette smoke, and similarly half of the mixed pipe and cigarette smokers never inhaled pipe and cigarette smoke.

TABLE VI - RR<sup>1</sup> OF LUNG CANCER BY YEARS OF PIPE USE AND BY TYPE OF CIGARETTES SMOKED (CASES/CONTROLS)

Pipe use (yr)	Type of cigarette smoked				Adjusted RR <sup>2</sup> on cigarette smoking characteristics (95% CI)
	0 cig	Mostly filter	Mostly non-filter, mostly dark	No filter, all dark	
≤ 10	1.00 (0/5)	2.68 (4/18)	4.09 (6/17)	6.01 (26/48)	1.00
> 10	1.17 (5/51)	10.04 (10/11)	7.21 (9/14)	3.67 (21/64)	1.04 (0.63-2.74)

<sup>1</sup>All RR were calculated versus only pipe smokers for 10 yr or less. <sup>2</sup>Chi-square test of homogeneity was not significant.

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TABLE VII - RR<sup>1</sup> OF LUNG CANCER BY FREQUENCY OF INHALATION OF CIGAR, PIPE AND CIGARETTE SMOKE ACCORDING TO SMOKING HABITS

A.									
Frequency of inhalation	Cigar smoke inhalation								
	Cigar only smokers			Cigar and cigarette smokers					
	Cases	Controls	RR	Cases	Controls	RR			
Never	6	28	3.9	35	101	6.1			
Sometimes or rarely	1	0	—	2	15	2.4			
Always or usually	2	1	36.1	30	28	19.4			
p-value for trend			<0.01			<0.01			
B.									
Frequency of inhalation	Pipe smoke inhalation								
	Pipe only smokers			Pipe and cigarette smokers					
	Cases	Controls	RR	Cases	Controls	RR			
Never	5	48	1.9	45	125	6.5			
Sometimes or rarely	0	6	—	15	23	11.8			
Always or usually	0	2	—	16	24	12.0			
p-value for trend						<0.05			
C.									
Frequency of inhalation	Cigarette smoke inhalation								
	Cigar and cigarette smokers			Pipe and cigarette smokers			Cigarette only smokers		
	Cases	Controls	RR	Cases	Controls	RR	Cases	Controls	RR
Never	30	82	6.6	22	88	4.5	312	598	9.4
Sometimes or rarely	3	15	3.6	10	23	7.9	116	185	11.3
Always or usually	35	47	13.4	44	61	13.0	870	973	16.1
p-value for trend			<0.07			<0.01			<0.06

<sup>1</sup>All RR were calculated versus non-smokers.

## DISCUSSION

Several studies have shown that pipe and cigar smokers have higher lung cancer mortality rates than non-smokers, but a lower risk of developing lung cancer than cigarette smokers (US Surgeon General, 1979). The results in our study are consistent with those reported in the literature: in relation to rates for non-smokers, lung cancer risks for lifetime cigar and lifetime pipe smokers (RR = 5.60 and 1.61 respectively) were increased, but to levels below those seen for lifetime cigarette smokers (RR = 13.32). Moreover, mixed cigar and cigarette smokers, and mixed pipe and cigarette smokers, were at intermediate levels of risk (RR = 8.53 and 7.98 respectively). These results are similar to those reported in the overall international case-control investigation (Lubin *et al.*, 1984b). The lack of significance of most relative risks associated with pipe smoking is likely to be due to the small numbers of pipe smokers.

The low number of patients in our study having smoked cigars or pipes exclusively can be explained by the fact that, in France, the sale of cigars and pipe tobacco represents a very slight proportion of that compared to cigarettes. For example in 1980 cigarette sales were 13 times higher than cigar sales (Hill and Flamant, (in press).

The differences in levels of risk can be explained by inhalation patterns: the vast majority of exclusive cigarette smokers inhale smoke, whereas most exclusive cigar or pipe smokers do not (Lubin *et al.*, 1984b).

Similarly, the proportion of both cigar and cigarette smokers who inhale is intermediate between that of exclusive cigar and exclusive cigarette smokers (Lubin *et al.*, 1984b). These differences in inhalation practices could be explained by a greater alkalinity of the smoke of pipes or cigars which is more irritating to the respiratory tract; and therefore reduces the depth of inhalation (Bailey, 1984).

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